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Implementing Handheld Computers as Tools for First-Grade Writers

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SUMMARY. All humans use objects in their environment as tools for actions. Some tools are more useful than others for certain people and populations. This paper describes how different first-graders used handheld computers as tools when writing. While all 17 children in the observed classroom were competent users of their handheld computers, their use of handhelds for pre-writing differed among the students. Some students' thinking was clearly enhanced with the use of handhelds before writing. Other students showed writing competence without referring back to their pre-writing work on the handheld. No students were unable to operate their handhelds in the pre-writing process.

KEYWORDS. Handheld computers, primary children, elementary, writing, handheld educational software, pre-writing process

First-graders in the classroom of a suburban elementary school were comfortably beaming a part of their assignment to each other in March. Because they'd been using their handheld computers since September, these first-graders were competent with many of the options available for them. The researchers' particular purpose for observing in the classroom for the following month was to learn how students used their handheld computers (e.g., PALM, Sony, and CLIÉ) as learning tools, particularly when using them for pre-writing.

Young children come to school with a broad understanding of technology because they don't ever know it is not supposed to be natural, and they see those communication tools in use by the adults around them. Edwards and Willis (2000) define literacy as the ability to read and write messages to accomplish the goals of recording and preserving experiences; reflecting upon, exploring, and extending one's thoughts and feelings; and communicating and sharing ideas with others. Incorporating handheld computers as one of the symbolic media of literacy extends it into one more arena beyond traditional visual images of letter drawings, sculptures, letter symbols, paintings, etc. The handheld computer becomes one more tool in the environment useful for literate activities.

HANDHELD COMPUTERS IN SCHOOLS

Norris and Soloway (2003) describe results of using handheld computers with third- through ninth-graders, but some might question whether first-graders could also competently use that technology. Handheld computers are being touted as the future of technology in schools because of reasonable cost for one-on-one access as well as convenience. More educational software continues to be developed for handheld computers.

Effective curriculum is necessary for any technology to be worthwhile in schools (Norris & Soloway, 2003; Pownell & Bailey, 2001). While handheld computer software has some powerful data-processing capabilities that support business uses, educational programs are not as numerous. But this first-grade teacher used some of those built-in capabilities in different ways with her first-graders. For instance, the address book became the alphabetized spelling word list. Students entered their own useful words as well as words that were pertinent to classroom curricula for handy reference when writing. The address book feature was also used to group words into various categories for easy reference. For example, soccer was placed in an address book category labeled sports. The notepad became a piece of paper on which students drew pictures and wrote words to answer morning work questions. This program replaced the half sheet of scrap paper normally used. The students turned their work in by beaming their notepad document to the teacher's handheld. The notepad was also used for taking notes while on field trips. Students wrote words or drew pictures of what they had observed. Students occasionally used the memo pad for editing practice. The teacher beamed sentences that needed editing to the students. They edited directly on the memo pad and then beamed it back to the teacher's handheld. Thus, the regular curriculum of first-graders became the handheld curriculum; curriculum was not dictated by the technology tool's specialized software.

THE BEGINNING WITH HANDHELD COMPUTERS

The observations took place in a first-grade classroom in a middle- class suburban school district in a large metropolitan area. In the spring of 2001, the teacher borrowed a classroom set of handheld computers from the local university for one week. The class used the handhelds for observing their plant growth in science class. The students drew pictures of their plants each day in a program called Sketchy–educational software developed at the University of Michigan. At the end of the observation period, the students could then run the program like a movie to see their plant growing. The handhelds were also used in a writers' workshop. The students used PiCoMap, a graphic organizer software also developed at the University of Michigan, to plan their story. They then used the planner to write their story on paper. This program was also used for planning their daily journal entries. During language arts, this program was used as a sorting and classifying tool. A PiCoMap was beamed to the students with words from the story of the week. The students then had to manipulate the bubbles in the organizer to sort the

words into categories that made sense. Students worked together, and some who struggled with writing on paper with pencils were more successful on the small handheld screen. Another success was the effect on the interactions between students. The first-graders became adept at assisting each other when someone had a problem with a handheld.

As a result of this initial success, the teacher wrote and received a grant for a classroom set of PALM® handheld computers. Putting into place a classroom set of handhelds was a daunting undertaking. A new set of electrical outlets had to be installed in the classroom. A rolling cart was obtained for storage, and three outlet strips and nine triple-plug adapters were used for power to the twenty-five handheld cradles. The handhelds also had to be checked and labeled. Each first-grader was responsible for labeling and checking his/her own handheld computer, and each handheld had to be named and set up with the teacher's laptop for syncing. This process took about two weeks to complete. Once this process was completed, students learned about the day-to-day operations of handhelds. They learned how to remove them from their cradles, hold them, carry and open them, and then replace them properly in the cradles. They also learned the main features of the devices in those small-group sessions. Once everyone had completed this process, the teacher introduced the students to the useful handheld programs in whole group sessions. A camera and projector were used to display the teacher's work on a large screen so the class could view it during instruction.

As the students in this first-grade classroom worked with their handheld computers throughout the year, they became oriented toward ways the computers could be used for different experiences. They were learning the strengths and limitations of the computers–as was the teacher. The capability of beaming was used for almost every lesson. The teacher beamed prepared documents or quizzes to a few students. Those students then spread out and beamed to others. As each student received the document, he/she then beamed the document to another student. Thus, all students had the document or quiz on their handheld computers within one to two minutes.

Technology and Elementary Writers

Lee (2000) surveyed teachers from across the nation about their use of technology in language arts classes and found that many did not be lieve technology was worth the trouble. Computers that crashed, lack of lab time, and server problems were some of the barriers teachers noted. This first-grade teacher has found that handheld computers mitigate some of those issues (e.g., the need for a lab and server), but crashed computers and lost data can still create problems. First-graders, however, are very flexible and quite willing to move on with another tactic. "Technology has everything to do with literacy. And being able to use the latest technologies has everything to do with being literate" (Bolter as cited in Wilhelm, 2000, p. 4). As our young students enter the world of reading and writing, they have had multiple exposures to various media and bring to school sophistication about technology that many adults are just now grasping. But, becoming literate is more than watching a television program about reading and

writing; it means engaging in literate activities. When technology is a tool toward that end, it can enhance the whole learning process of our already techno-literate children.

HANDHELD COMPUTERS AND WRITING

Students in this first-grade classroom used the capabilities of their handheld computers in different ways in their writing activities, and as Edwards and Willis (2000) predicted, different students found different possibilities for action with those computers as they prepared to write with their computers using the pre-writing tools on their handhelds. Children emerging into literacy naturally manage the symbol systems with differing degrees of competence. Only after they have had many experiences with writing about ideas and events and making lists and drawings to communicate are they ready to consider using a pre-writing organizer. Children in this first-grade classroom wrote every day–usually without handhelds. They wrote in journals, wrote during science about what had just happened in an experiment, and they wrote in math to explain their learning. By April most students were comfortable with the assignments that included writing. Before the researchers' formal observation time, students used the address book often to find words they wanted to spell, and they had occasionally used PiCoMap to organize ideas for writing. The teacher had also decided to have children use the typing option when entering text into their handhelds. She was concerned that learning graffiti might interfere with the students' own developing handwriting skills.

Consequently, observational notes came from children interacting with their handheld computers prior to and during their composing pieces with traditional paper and pencil. Keeping in mind some differences in available writing time during each observation session and different levels of engagement with writing topics, researchers considered the actions and written work of students when using handhelds with two different pre-writing conditions after observing them write without handhelds. These observations began to paint a picture of the competence shown by 17 first-graders. In this article we have retained the original spelling from students' written works to share the developmental nature of their work.

PRE-WRITING STRATEGIES WITH HANDHELDS

These first-graders used both PiCoMap and Sketchy programs as pre-writing tools. As we observed their use of handheld computers under these circumstances, we saw interactions that we interpreted as indicating their differing uses of those computers for action in their classroom. All students used their handheld computers, but they did not use them in exactly the same ways, nor did they achieve the same results in their writing. Some seemed to find the use of handheld computers more helpful than others–perhaps because the handhelds were motivational, perhaps because they were more manageable, or perhaps because they were tools that granted them guidance for the writing task.

When students used PiCoMap as their pre-writing guide, the teacher first modeled the process by talking about how she would write about her grandmother (the main idea in the center oval) and by using details to describe her (the outer ovals surrounding the center oval). The teacher told students to start with a chosen main idea or person in the inner oval and then write details in the outer ovals about that main idea or person.

As students began this pre-writing, they immediately found the appropriate program for the task at hand. No one hesitated or struggled with forming a central oval and then various outgoing bubbles or ovals. In fact, one student drew a strange angular shape and said with a grin on his face, "Even this will make a bubble."

Similarly, before students used Sketchy as a pre-writing tool, the teacher asked them to think about somewhere they had gone and the things they did on that "adventure." After students had shared some of their own ideas, the teacher instructed them to first draw actions on five or six Sketchy frames and then use those actions to help them write their stories. Once again, students chose the correct software and began to draw or write on the Sketchy frames.

STUDENTS' WRITING SUCCESSES WITH HANDHELD COMPUTER PRE-WRITING

Researchers' observations while students were writing and the pieces written indicate that students varied in the ways they used their handheld computers and these particular software pieces as support for writing. One language-delayed student showed delight when she was able to use her Palm®. In previous observations of her writing, this student had avoided the task of writing by sharpening her pencil, washing her hands, and getting a band-aid. The day that she used PiCoMap, she eagerly drew the ovals and wrote a sentence in the circles, one word in each circle: "Aftrsu, grandma, bakt, cookies." Although she didn't do precisely what the teacher had told students to do (write the main idea and details about that idea), she eagerly wrote her words, getting some help spelling the words "grandma" and "cookies." Then the teacher drew four boxes on her paper, and the student wrote one word in each box: "My gra bacing cookes" This was more writing than she had done in the previous two visits during writing time when students did not use handheld computers.

When this student was ready to start with Sketchy, the teacher initially provided guidance to help her get started sharing about her trip to Disney World. The teacher asked, "What was your first thing?" The student said: "Pack a suitcase. I went last year in Kindergarten. We stayed in a Bed and Breakfast." She used block pieces to draw the suitcase in Sketchy and said, "It was hot. It got to be 100 degrees." She then went on to draw the following pictures and described them as well: Frame 1– She drew a really big black suitcase. "I have two little ones too with toys in it." Frame 2–She played with the circle arc a bit and then drew the bed and breakfast place. "There was no diving board. Mostly in the evening it was hot. There were croaking lizards." Frame 3– She drew the lizard. "This is where it goes in and croaks. I tried to catch them, but I couldn't." Frame 4–She drew a pool. "This is the pool, and there was a drain in that pool."

Although this student never wrote any of this down on paper, she described her trip orally as she drew the pictures. This oral language fluency accompanied her use of the handheld computer. This student's interactions with her handheld and its stylus indicate that she saw the handheld computer as a tool for her literacy. Perhaps drawing was also comfortable for this girl, but she did not limit that to pencil and paper. Her computer was also a tool in the environment that she could use competently for her own literacy.

Some of the students used the PiCoMap pre-writing strategy as the teacher had instructed and wrote pieces that were guided by the connected ideas from the map on their handheld. These students were fluent writers under all circumstances, and the use of handheld computers was workable for them, but did not seem a necessity as a pre-writing tool. Another girl and boy are examples of these students.

This girl used the inner oval for her main idea (Mom) and the outer ovals for ideas about her mother. As she was working on her PiCoMap, she said: "I added arrows. We can make our own arrows on this. They help us to keep our thoughts together so they don't go all around." The importance of focusing on the topic at hand helped her transform her PiCoMap ideas into these sentences she wrote after making her PiCoMap: (/ indicates child's line break.) I like my Mom. / She is nise. / She helps pepole. / She likes too read storys. / She likes to bakes cokes. / I love mom. When using Sketchy as pre-writing support, she drew about her trip to the park with very detailed pictures. She said: "I'm going to write about the park. When we click okay, we can't change the names." She further described each of the pictures she had drawn: Frame 1–"I'm drawing a ladder and me going down the slide. We can just draw here with Sketchy. I like it because you can draw a lot of pictures on it, but not more than 50. Wow, I drew a heart as an eye! I can't draw very good on Sketchy, but I like how I draw the sun because the lines make it look really hot out." Frame 2–"Me swinging on the swings." Frame 3–"I'm making a sand castle." Frame 4–"Riding on duck–I forgot the sun" (She then added it). Frame 5–"Hopping stone to stone, there are five but I don't have room." Frame 6–"Little rope thing that you can climb up and climb back down." Frame 7–"I'm playing tag with Emma who is one year older than me. She's eight, but she's really nice. You can write on here too." Frame 8–"I was riding a bike." Frame 9–"I was having a picnic with sandwich, chips, and Sprite." Frame 10–"10, Monkey bars." Frame 11–"I was playing pirates. I know I look kind of weird." Frame 12–"I'm playing on the Merry-go-round. I'm going to need two pieces of paper to write about those 12 things." This girl, as other students in the class, was comfortable with moving through the frames on Sketchy to plan her writing as she remembered her adventure in the park.

This girl used the pictures to help her write the following piece on paper: *Over the weekend I went too the park. / When I got to the park I went down the / slide. And then I swag on the / swings. And then I made / a sandcasle. And I swag on / a boucke. And I Jumpt too / stons. And then climde up / a wallee of bores. And then I / played tag. and then I rod / my bike. and then I had / lounch. and then I did the / mockey bores. and then I played / pirrit's. and then I played / on the merice.*

The boy got right to work with his map after instruction with PiCoMap, and put Ryan as his title and in the center oval. Although he visited some with neighbors while making ovals and typing in words, he kept working with ease. He put play, game, cosin, and run in his outer ovals. This preplanning set up for his writing: *Ryan is my cosin. / Ryan like to play. / He like to play grns. / He like to run fast. / Ryan like to play/ gams. The close connection of bubbles and final text indicate the boy's use of the handheld's PiCoMap to help him organize his writing.*

As did the previously mentioned first-grade girl, this boy had 10 frames in Sketchy for his story about going to Chuck E. Cheese. He did choose to write on the first two frames, an option in Sketchy that is like built-inPALM® Notepad software. Those two frames set the stage with title and author. Frame one is "Chuck E Cheese," and two is "by Author." Frame three is a slice of pizza and the remainder include people and other things, each indistinguishable to anyone but this particular student. His resulting writing is connected to his theme and fits with his setup on the handheld. *I went to Chuck E. Cheese. At Chuck E. / Cheese I eat hamburger / pizza. I like to go / play Ninjas tuttls. / I like to go in the/ tonols. At Chuck E / Cheese I saw to pichshers / thair. I ride with Chuck E. / I played basketball / thair.*

There were a few students in this first-grade classroom who, although very competent with their handhelds, did not seem to find those particular strategies necessary or helpful for their writing. When using only paper and pencil as their tools, two fluent writers seemed to organize their writing in their minds, and they were not noticeably aided by PiCoMap or Sketchy. In fact, after one writer filled in several ovals about her father, she never looked back at the PiCoMap while she was writing the following sentences: My papa is funny. He calls / Me Walliy dolley. H also calls / Me drerk I say I'm not but / He says you are. When I don't / Now how to turn on the T.V. / Cause they have sepeshle way / To turn it on. He likes glof / Bascetball football fishing and / Swimming. I thick he likes / Soccer I'm not sherow. But I do / Now one thing that he doesn't / Like is dancing and singing. He / Liys some times he hits me / On the head with a pilwwow / And his hand. One time at / His house he hited me on the / Head with a pilwwow but he said / He didn't. He has his on desk / It has a computer a slef coberd / And a kind of desk in front of him.

Another student's writing seemed somewhat hindered when using PiCoMap and Sketchy. While she had written over 100 words when no handheld was used, her PiCoMap and Sketchy writings were minimal in comparison. With PiCoMap, she had "My friend" in the center oval with "my friend, henry, team, soccer, fany, sit together." Between the time she filled in PiCoMap and the time she wrote her piece, she seemed to have either changed her mind or chose to ignore the pre-writing work. Her written piece contained only 25 words: Tiffany is my friend. Tiffany / plays with me. Tiffany is nise. / Tiffany plays games with me / Tiffany play rte with me. / Tiffany is a gilr.

When using Sketchy her drawings were very detailed, but the writing was again sparse with 26 words about a trip to the zoo. Another student continued to write fluently after drawing 10 pictures that seemed to organize her thoughts. She drew detailed pictures of her trip to Aruba. When asked about her pictures, she said: "I went on vacation to Aruba. There's a place that has fishes and then you walk over a bridge to look at them." However, once she finished drawing

her pictures, she never looked at them while writing her detailed piece: *In summer I went to Aruaba. / We saw cats lose and parrets. I / Went to the pool. My cosen Madilen / And Andy where there. Madilen / And me saw a brid in the pool. / So we got it out with a stick. / I went on the bech to. There / Was hardly any seaweed. There's / A place where you go and only / Kids go. You can play really fun / Stuff. Like Bingo and uh oh / In Trouble. I got something from / My Mom and Dad. I got some / Bead's. There whor fish to feed / Bread to. And Iqonas running / Aroud And lizzerds. It was / Really really really fun. We stad / There for ten days*

Patterns of Success

Although students responded differently to the writing task with handhelds as a pre-writing tool, all first-graders in this teacher's classroom demonstrated comfort and competence when using their handhelds. When using PiCoMap, most students used the main idea as the center oval and then used other ovals as details about the idea. Different writers used their maps in different ways. When using Sketchy, students moved from frame to frame and either drew or wrote ideas. Again, all of the first-graders operated the software without needing help at that point in the year. Drawing is an important part of emergent literacy, and handhelds afforded students another medium for using that literate action.

For fluent writers, the handheld probably wasn't necessary for pre-writing, although it often helped them to organize their thoughts and brainstorm ideas to write about the topic. For those students who were not as fluent with their writing, the handheld was their literacy tool, and it usually invited them to express literacy in writing or in speaking. Handhelds also seemed to be motivating–students were eager to begin work with them. In fact, one boy chose not to continue writing in the no-handheld setting because he couldn't use the address book to find how to spell words.

GETTING STARTED WITH HANDHELD COMPUTERS

Before bringing this new technology into a classroom, a teacher should be very familiar with the use of the particular handheld computer that will be utilized, as well as be aware of possible uses to help students learn. This teacher completed a graduate course on the subject and read several books and articles before starting the project. Also, she visited with teachers who had such projects underway. Trying to develop a vision for handheld use is important to successful use. Clearly, this first-grade teacher is comfortable and competent with handhelds herself. She is aware of the possible technological glitches and has had to solve problems "on-the-fly." One continuing problem is breakdown of some of the handhelds. Several handhelds stopped working over break, and they had to be replaced with refurbished handhelds, and it took several weeks for their return. This was difficult, because students need to have their own handhelds to gain the full benefit. Time spent using the handhelds during these times was greatly reduced.

In order to facilitate classroom management, an area of the room dedicated to the set of handhelds is important. This area needs to be away from the main traffic of the room, but still convenient for students and teachers to access. The storage area can include cradles for charging the batteries and an area to store the handhelds when not in use. These first-graders were responsible for syncing the handhelds to the teacher's laptop. Two students were assigned each week to complete this process. It does take a fair amount of time for this to be done, and this procedure is still being refined. Security of the devices is an issue that also needs to be addressed.

The use of handhelds in classrooms adds one more element into the learning environment. As with any component of a classroom, handheld use adds to the complexity of the room. Early in the adoption of handhelds, policies and procedures need to be established, such as when the handhelds can be taken home, what can be downloaded onto them, when the device should be synced and backed up, who does this task, and what computer(s) should be used for syncing. Also, policies must be set for any lost or damaged handhelds. These types of management issues need to be addressed and a written policy completed and shared with all involved.

With young children such as these first-graders, additional caution needs to be taken when teaching students how to set their computers into the cradles. The teacher in this study found that when handhelds were not set into the cradle properly (sometimes due to tight fitting cradles or prongs that were slightly askew), some handheld batteries did not recharge and data were lost. It was also vital that students synchronized their work each time they put away their handhelds to avoid those losses. This requires additional time management.

From the beginning of use, students need to understand that this is a learning tool, not a toy. Games should only be played if there is a value tied to the curriculum and the teacher approves. Students need to understand that there are appropriate times to use their handhelds and that the teacher will help them with determining these times. Also, administrators, parents, and the community need to be informed of the intended uses and the value that is expected from these experiences.

CONCLUSION

Handheld computers can be appropriate tools for first-graders. The benefits of using handhelds in this classroom were dramatic for some students. The students who struggled while writing with paper planners had very few struggles when using the handheld. Students were almost always on task with handhelds, and the need for teacher interaction was low. It appears that handheld computers can be used by young writers as supportive tools, particularly for emerging and developing writers. Some students (the least fluent writers) preferred writing on the handheld to actually writing on paper. Others (the somewhat fluent writers) used their handheld to enhance their writing. Still others (the most fluent writers) probably could have written without the pre-writing done on the handhelds, but it was not a deterrent to writing for

most of them. Handhelds have also been key in promoting positive interactions between classmates as well as increasing the level of student responsibility.

Even though it is clear to us that children as young as six can benefit from the technology of handheld computers, teachers themselves have to first become users and problem solvers. This is not a new issue in teaching, and inertia is a continual challenge for changes in the educational arena. Teachers have historically taught the way they were taught, and the impetus for change cannot be top-down (Salomon, 1998). This first-grade teacher is now teaching other teachers about using handhelds for instruction. As these small computers become useful tools for teachers, they will be more available as tools for the young students in their classrooms.

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